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CORN TOPPING -- Its Effect On Field Drying and Harvesting 1/

by

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Despite the conflicting reports over the past several years on the effects of corn topping, farm managers and equipment manufacturers have recently shown more than a casual interest in the practice of topping prior to harvest. This interest has given rise to a number of questions. Does corn topping hasten rate of field drying and increase harvesting efficiencies by reducing lodging and the amount of stalk material going through the machine? Does it reduce yields or affect the quality of the corn? If it is effective, when should the topping operation be performed?

Previous researchers 3/, reporting on the effects of corn topping, have suggested that yields may be reduced by as much as 13.6 percent with very little increase in the rate of field drying due to field topping.

1/ The material in this paper reports results of cooperative research between the Agricultural Engineering Department, Iowa Agricultural and Home Economics Experiment Station, and the Agricultural Engineering Research Division, ARS, USDA. Iowa Agricultural Experiment Station Project No. 1331.

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3/ Grogan, C. A. Detasseling Responses in Corn. Agron. Jour. 48: 247-249. 1956.

Kiesselback, T. A. The Detasseling Hazard of Hybrid Seed Corn Production. Agron. Jour. 37: 806-811. 1945.

Willard, C. J. Does It Pay to Top Corn? What's New in Crops and Soils, 11 (7): 15. 1959.

In 1958 agricultural engineers of the United States Department of Agriculture and the Iowa Agricultural Experiment Station ran a series of experiments to determine the effects of corn topping on rate of field ear drying and harvesting losses. A summary of the 1958 report[4/] states that no significant differences were found between topped and untopped corn. Kernel-moisture content, cob-moisture content, stalk breakage, yields, pre-harvest losses, and machine losses were about the same for topped and untopped corn.

To substantiate these findings and obtain additional information, experiments on corn topping were continued in 1959. This paper is a report on the results of the 1959 experiment.

DESCRIPTION OF THE EXPERIMENT

The 1959 experiment was similar to the 1958 experiment but somewhat more comprehensive. In this experiment the effect of corn topping on kernel-moisture content, cob-moisture content, shelling percentage, test weight, stalk breakage, pre-harvest losses, and harvest losses were studied.

The corn variety planted was Iowa 4570. The statistical design used in this experiment was a split plot with three replicates. Each whole plot, consisting of 20 rows 150 feet long, was divided into two subplots of 10 rows each. One subplot was planted early in the season (May 1, 1959) and the other late in the season (June 10, 1959). These two extremes in planting dates were used to compare the effects of topping on early- and late-planted field corn.

Two rows of each subplot were selected as field drying sample rows from which all moisture samples were removed during the course of the experiment. The remaining 6 rows between the two border rows were subdivided into 3 sub-subplots to compare efficiencies of harvesting machines. In other words, within each subplot receiving the same topping treatment were 3 sub-subplots of 2 rows each for the 3 different types of harvesters to be used and 1 sub-subplot for sampling purposes. The sub-subplots assigned to each machine were randomly chosen within each subplot.

4/ Schmidt, J. L. and Lovely, W. G. Report on Effects of Corn Topping, USDA Agricultural Research Service, ARS-42-35, 10 pp. August 1959.

The topping machine was set to cut the stalk just above the highest ear in the row. This amounted to cutting off the tassel and the top four or five leaves of the stalk. The four topping treatments were:

Treatment 1 - Approximately 10 days after pollination.

Treatment 2 - When the kernel-moisture content was about 70 percent 5/ (in roasting ear stage).

Treatment 3 - When the kernel-moisture content was about 50 percent (in dented stage).

Treatment 4 - When the kernel-moisture content was about 38 percent (in final maturing stage).

Treatment 5 - Untopped check treatment.

The rotary topping machine, shown in figure 1, used in 1958 was also used in 1959.

Random samples of seven ears were taken from the sample rows of each subplot throughout the season, making a composite sample for the three replicates of 21 ears for each treatment. To closely check the kernel-moisture variation immediately after topping, samples were taken three times a week on the plot just topped. Two weeks after topping, samples were taken once a week. Untopped corn was sampled three times a week throughout the season.

The first sample on the early-planted corn was taken on August 1 -- the kernel-moisture content was about 88 percent. The last sample was taken on November 20 -- the kernel-moisture content was 15.5 percent. Late-planted corn was first sampled on August 24 -- kernel-moisture was 83 percent; the last sample was taken on November 20 -- kernel-moisture, 21 percent.

Every sample taken during the season was processed to obtain the kernel-moisture; frequently the ears were completely shelled to obtain information on cob moisture content, shelling percentage, and test weight.

5/ All moisture contents were determined on a wet-basis.

The early-planted corn was harvested November 4 and the late-planted corn on November 28. At harvesttime a count of total stalks as well as lodged stalks was made. Immediately before harvesting, all down ears were hand-gathered to determine preharvest losses. A combine, a mounted picker-sheller, and a mounted picker were used, and all were equipped with two-row picker heads.

Prior to harvesting plastic sheeting was laid down at random positions along the rows to obtain estimates of shelled corn losses. The material on the sheets and all missed ears were hand-gathered after the corn was picked. These two items were used to estimate corn losses at the snapping rolls. In addition, all trash and cobs from the combine and picker-sheller were caught to determine separating losses. There were no separating losses associated with the picker.

The corn gathered by each machine was weighed and designated as machine yield. Total yield was determined by adding machine yield, preharvest losses, snapping roll losses, and separating losses.

RESULTS

Kernel moisture content

The variation of the kernel moisture for both early- and late-planted corn as a function of sampling date is shown in figure 2. The solid lines show the trend change in moisture content of the 1959 untopped corn. For comparison the 1958 kernel drying data are also presented and are shown by the dotted line.

Owing to different weather conditions for the 2 years toward the end of the drying period, the drying trend for 1958 is quite different from that of 1959. In 1958 there was practically no precipitation during the last week of September and the entire month of October. In 1959, however, rainfall during these 2 months was greater than normal. During the last 2 weeks of September and the first 2 weeks of October the relative humidity was high and it rained nearly every day. This unusually extended period of continuous wet weather explains the reason for slower drying in 1959 of the early-planted corn after maturity and the late-planted corn at the higher moistures. In good drying weather such as occurred in 1958, corn continues to dry at a rather rapid rate to a moisture content of 20 percent or even lower. Precipitation data for September and October of 1958 and 1959 are presented in table 1.

On five dates during the period of August 19 to September 23 (August 19 and 26, and September 2, 16, and 23) replicate samples were taken in the early planted corn. Kernel moistures in treatments 1, 2, and 5 were analyzed over this period and showed a significant difference (5-percent level) only between kernel moistures of the untopped topped corn 10 days after pollination. No significant differences were found between any of the other topping treatments and the untopped corn although there was a trend toward lower kernel moisture contents for the topped corn. Some average kernel moisture variations of early- and late-planted corn for different topping treatments and dates are given in table 2.

Contrary to the results found in the early-planted corn, no significant differences were found between kernel moisture contents of topped and untopped late-planted corn. Even the presence of the trend toward lower kernel moisture contents observed in the topped, early-planted corn was absent. These results for late-planted corn are very similar to those obtained in the 1958 experiment for corn planted in mid-May.

Under the planting and growing conditions encountered in 1959 it appears that the topping of early-planted corn prior to harvesting did tend to increase the field drying rate sufficiently to change the harvest dates somewhat although the topping of late-planted corn did not. If 20-percent kernel moisture is accepted as a suitable criterion for harvest, then according to table 2 or figure 2 all topped corn could have been harvested on about October 16, approximately 11 days before the untopped corn reached 20 percent. These 1959 studies indicate that there may be certain conditions where topping could change the harvest date by several days. However, as indicated by table 3, this may be at the expense of a reduction in yield due to early topping where corn topped 10 days after pollination yielded approximately 11 bushels per acre less than untopped corn.

Cob moisture in relation to kernel moisture

The 1958 studies indicated that topped corn tended to have a higher cob moisture content relative to the kernel moisture than untopped corn. This was also evident in the 1959 studies, especially in the late-planted corn where corn topped 10 days after pollination had a significantly higher cob moisture content with respect to kernel moisture than the untopped corn.

Though no significant differences were found between cob moistures (relative to kernel moistures) in early-planted topped

corn and untopped corn, cob moisture contents in topped corn, as in 1958, tended to be higher. This was especially true of corn topped early in the season. Figure 3 shows a plot of cob-kernel moisture relationship for 1959 early- and late-planted corn for the different topping treatments. These results indicate that topping upsets the normal cob-kernel moisture relationship.

Shelling percentage

Shelling percentages (the ratio of wet kernel weight to wet ear weight times 100), as in 1958 showed no significant differences between topped and untopped corn planted early or late in the season. However, there was a slight trend toward lower shelling percentages for topped corn.

Test weight (pounds per bushel)

As in 1958 topping had no effect on test weights for early- or late-planted corn. As in shelling percentages, a slight trend toward lower test weights was observed in topped corn.

Total yields (bushels per acre)

The average total yields for both dates of planting are shown in tables 3 and 4. Topping had no statistically significant effect on total yields. However, there does seem to be a trend toward lower yields associated with topping, especially in the corn topped 10 days after pollination. This trend is more evident in the early-planted corn. There were some yields in the topped late-planted corn which were higher than the untopped corn. These results are similar to the 1958 findings.

It is interesting to note that in the studies for both years the lowest yields occurred in corn topped 10 days after pollination. These observations point out that extremely early topping tended to reduce total yields. This was probably due to excessive plant injury caused by early topping.

Stand count

Naturally, topping had no effect on the number of stalks per acre in either early- or late-planted corn. The average number of stalks per acre (tables 3 and 4) in the late-planted corn was sub-

stantially lower than in the early-planted corn. This was due to the adverse weather conditions at the time of planting of the late-planted corn giving rise to poor germination of the seed.

Lodging

Differences of down stalks between treatments were so small as to be not significant. A stalk was considered down or lodged if it was bent over to such an extent as to allow the ear to touch the ground. The percent lodged stalks is also tabulated in tables 3 and 4.

Preharvest losses

Preharvest losses as measured by loose ears on the ground were not significantly different between topped and untopped corn of both planting dates. This was also true in 1958.

Machine losses

Topping had no effect on machine losses as measured by ear and shelled corn losses at the snapping rolls and shelled corn in the trash. This was true of both planting dates. There were significant differences between harvesters with the picker sustaining the highest losses and the combine, the lowest; but such results are generally characteristic of these machines. Similar results were found in 1958.

Total harvesting losses

Total harvesting losses (preharvest losses plus machine losses) were not materially affected by topping for either of the two planting dates. These results are also similar to those of 1958.

As part of the 1959 topping studies three fields of corn of approximately 20 acres each were selected from bulk corn areas farmed by the University Farm Service.

When the corn reached about 35 percent kernel moisture, every other set of 4 rows was topped across each field. The harvesting machine when moving across the field alternately would be operating in topped and untopped corn. By such an arrangement it was possible to make some general qualitative, rather than quantitative, observations on the effect of topping on machine performance and operator comfort, visibility and reactions.

Observations of machine performance were limited to counting the number of times the heads plugged and the snapping roll clutches slipped during runs the length of the field. These counts were made for several different speeds of operation. While sufficient data were not taken for a statistical analysis, it seemed that the machine was able to travel faster with less clutch slippage or plugging in the topped corn than in the untopped corn. This was also the combine operator's opinion after having completed harvest.

The operator definitely preferred working in topped corn. He claimed that the main advantages were better visibility of the rows allowing him to guide the gathering heads more accurately and less dust and chaff blowing around the seat due to the absence of whipping corn tops when the stalks hit the snapping rolls.

These results are, of course, of a very general nature because intangible items such as operator comfort, visibility, and the like are very difficult to measure quantitatively. Additional studies must be made before the true relationship between topping and these factors can be established.

SUMMARY

The results of the 1959 experiments are very similar to those obtained in 1958. For the early corn, the kernel drying rate was significantly greater (5 percent level) than untopped corn only on corn topped 10 days after pollination. Topping did not seem to have any effect on the kernel moisture in the late planted corn regardless of the date of topping. Test weights and shelling percentages, though not significant, tended to average slightly lower in the topped corn. Cob moistures in relation to kernel moistures tended to average slightly higher in the topped corn. Though total yields were not significantly different, there is a tendency toward lower yields in the topped corn, especially in corn topped very early in the season, that is, 10 days after pollination.

Stands, lodging, preharvest losses, machine losses, and machine yields did not show any significant differences due to topping for either planting date.

Observations of field-scale operations indicate that topping improves the comfort and visibility of the picking machine operator.

Figure 1. Rotary corn topper mounted on high clearance spraying machine set to cut the tassel and the upper 4 or 5 leaves of the stalk.

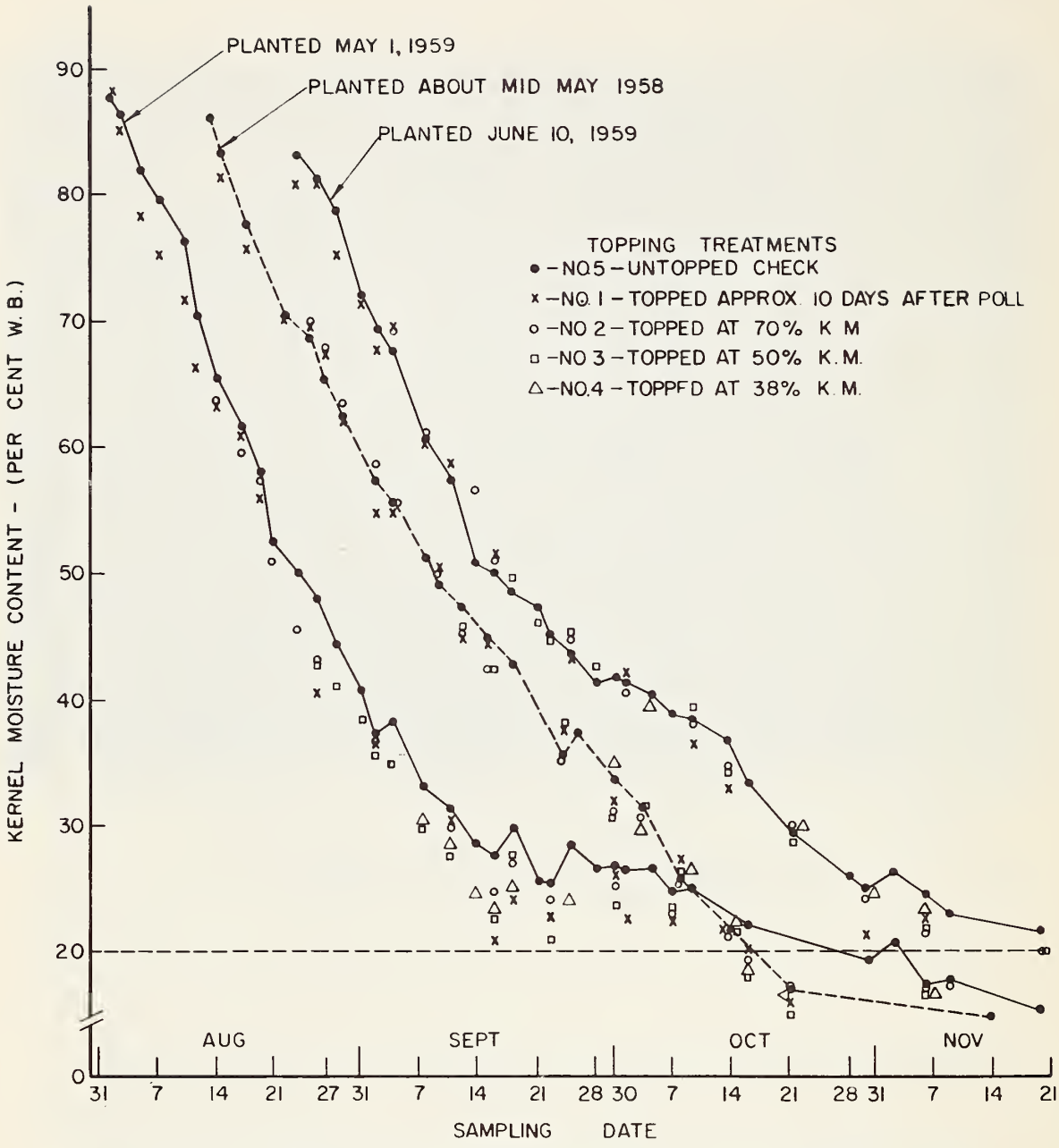

FIGURE 2. VARIATION OF KERNEL MOISTURE CONTENT WITH DATE

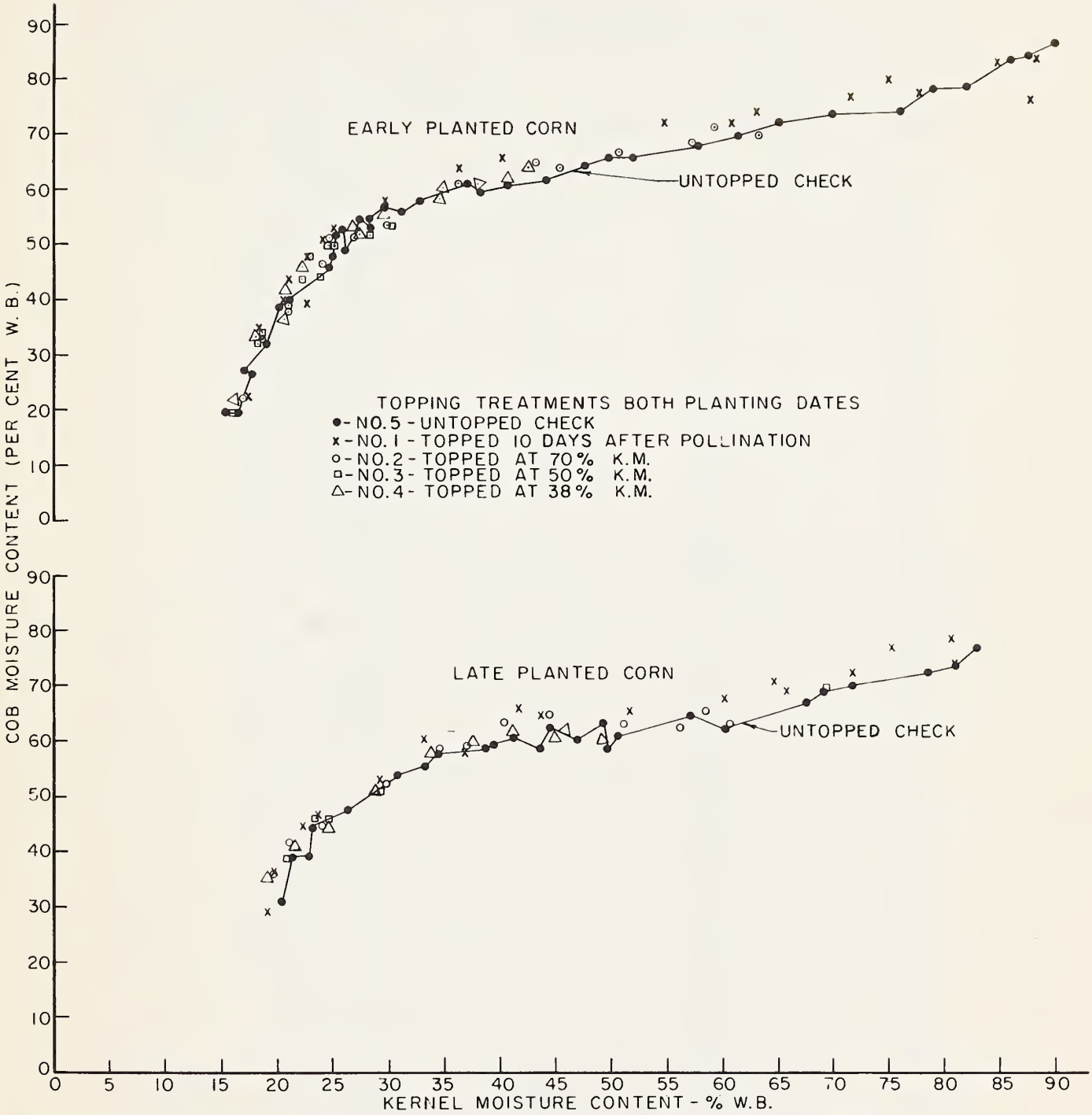

FIGURE 3. COB MOISTURE - KERNEL MOISTURE VARIATIONS

Table 1. -- Precipitation Data for Months of September and October For Years 1958 and 1959

1959		1958		
Date	Precipitation (in.)	Date	Precipitation (in.)	Normal for month
Sept.		Sept.		
1	0.10	3	trace	
2	1.48	5	1.63	
9	.08	6	.77	
16	.10	7	.03	
17	.15	9	.25	
18	.33	14	1.11	
19	.60	15	.02	
21	.07	17	trace	
22	.04	21	.06	
24	trace	23	.15	
25	.88	24	.05	
26	.48	30	trace	
27	.01		----	
30	trace		----	
Total	4.32	Total	4.07	3.31
Oct.		Oct.		
1	.04	7	0.13	
2	.95	8	trace	
3	.13	26	trace	
4	.22	27	trace	
5	.50		----	
6	.01		----	
8	.08		----	
16	trace		----	
17	.05		----	
22	.02		----	
23	.14		----	
24	trace		----	
25	trace		----	
26	.06		----	
27	.01		----	
30	.10		----	
31	.05		----	
Total	2.40	Total	0.13	2.05

Table 2. -- Kernel Moisture Variations Between Topping Treatments

Corn planted May 1, 1959						Corn planted June 10, 1959					
Sampling date	Treatment 5	1	2	3	4	Sampling date	Treatment 5	1	2	3	4
Aug. 26	47.8	40.3	43.3	42.8	-	Sept. 16	50.0	51.7	51.4	-	-
Sept. 2	37.2	36.4	36.5	35.2	-	Sept. 25	43.8	43.7	44.6	45.0	-
Sept. 11	31.3	29.6	29.9	27.5	28.5	Oct. 2	41.3	41.7	40.5	41.4	-
Sept. 16	27.7	20.9	24.8	22.3	23.1	Oct. 14	34.6	33.1	34.5	34.0	34.8
Sept. 23	25.4	22.8	24.1	20.8	22.3	Oct. 21	31.0	29.4	30.0	28.9	29.5
Oct. 7	24.8	20.8	21.1	20.9	21.2	Oct. 30	26.5	23.6	24.2	24.6	24.9
Oct. 16	21.1	18.3	19.2	18.4	18.7	Nov. 6	23.3	22.4	21.2	21.7	23.6
Nov. 6	17.3	-	17.2	16.7	16.4	Nov. 20	21.5	19.7	19.9	19.9	21.1

Table 3. -- The Effect of Topping on Yield, Losses, and Lodging for Corn Planted May 1, 1959. (Harvested November 4)

Item	Topping Treatment				
	10 days after Pollination	Kernel Moisture			Untopped check
		70%	50%	38%	
	1	2	3	4	5
Kernel moisture (% Wet Basis)	17.6	17.6	17.2	17.8	18.6
Gross Yield (Bu./A at standard 15.5% base)	109.8	107.8	118.6	114.4	120.9
Stand (stalks/A)	19,446	18,459	19,505	19,058	18,558
Lodging (% down stalks)	8.6	8.4	8.4	10.2	5.7
Preharvest loss (%)*	0.80	0.57	0.43	0.42	0.43
Loss from missed ears (percent)*					
Picker	6.36	5.35	3.30	8.53	3.24
Picker-sheller	5.63	4.16	3.91	6.40	2.58
Combine	4.30	3.23	2.82	3.94	1.98
Average	5.43	4.25	3.34	6.29	2.60
Shell corn loss at rolls (percent)					
Picker	7.99	12.17	10.93	9.38	10.24
Picker-sheller	5.47	5.04	4.37	5.10	5.84
Combine	2.31	1.63	2.00	3.24	1.30
Average	5.29	6.28	5.77	5.91	5.79
Shell corn loss in trash (percent)					
Picker	-	-	-	-	-
Picker-sheller	0.06	0.05	0.08	0.05	0.03
Combine	1.28	1.26	1.15	1.23	1.27
Average	0.45	0.44	0.41	0.43	0.43
Total Harvesting loss (percent)					
Picker	14.35	17.51	14.23	17.90	13.48
Picker-sheller	11.16	9.25	8.36	11.54	8.44
Combine	7.89	6.12	5.93	4.34	4.55
Average	11.13	10.96	9.51	11.26	8.82

* Percent of Gross Yield.

Table 4. -- The Effect of Topping on Yield, Losses, and Lodging for Corn Planted June 10, 1959. (Harvested November 28)

Item	Topping Treatment				
	12 days after Pollination	Kernel Moisture 70%	Kernel Moisture 50%	Kernel Moisture 38%	Untopped check
	1	2	3	4	5
Kernel moisture (% Wet Basis)	22.0	21.0	21.2	21.3	22.0
Gross Yield (Bu./A at standard 15.5% base)	68.9	74.3	80.7	83.6	75.6
Stand (stalks/A)	12,161	11,087	12,333	12,465	10,720
Lodging (% down stalks)	7.3	5.4	4.8	5.7	5.5
Preharvest loss (%)*	0.28	1.52	0.68	1.61	1.25
Loss from missed ears (percent)*					
Picker	6.76	5.57	4.10	4.65	5.62
Picker-sheller	3.16	5.85	2.75	5.93	4.21
Combine	4.49	3.50	5.68	2.77	3.55
Average	4.80	4.97	4.18	4.45	4.46
Shell corn loss at rolls (percent)					
Picker	7.24	12.13	8.65	8.83	6.97
Picker-sheller	5.98	5.44	5.62	6.38	5.12
Combine	1.49	2.67	1.43	1.06	1.18
Average	4.90	6.75	5.23	5.42	4.42
Shell corn loss in trash (percent)					
Picker	-	-	-	-	-
Picker-sheller	0.04	0.02	0.03	0.04	0.02
Combine	1.54	1.44	1.47	1.45	1.33
Average	0.53	0.49	0.50	0.50	0.45
Total Harvesting loss (percent)					
Picker	14.01	14.36	12.75	13.49	12.59
Picker-sheller	9.18	11.32	8.40	12.36	9.35
Combine	7.52	5.70	5.83	4.95	6.09
Average	10.26	10.46	8.99	10.27	9.34

* Percent of Gross Yield.